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First data on Sr isotopes in melt inclusions in olivine from 3.3 Ga Barberton komatiites: evidence for depleted source of primary komatiite melt and its near-surface contamination

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Olivine phenocrysts in Archean komatiites proved to be a good container for preserving melt inclusions (Sobolev et al., 2016, 2019; Asafov et al., 2018, 2020). Most primitive komatiite melts are enriched in H_2O and Cl, but depleted by incompatible elements such as K, Rb, Ba, Nb, La, and Pb. These results have been interpreted as a compositional feature of mantle plumes sources of komatiites produced by recycling degassed seawater altered lithosphere to the deep mantle, which experienced preceding melting episode. Surface contamination has been detected in all studied komatiitic suites but was not investigated in detail.

Here we present the first results obtained from olivine hosted melt inclusions from the Pioneer complex komatiites of the Weltevreden formation, Barberton Greenstone Belt (3.3 Ga), South Africa. Melt inclusions were homogenized and quenched in high temperature experiments, brought to the surface, polished and their geochemical features were studied by following methods: 1) EPMA for major and minor elements; 2) RAMAN microscope for water contents; 3) SIMS for D/H ratios and water contents; 4) LA-ICP-MS for trace elements and Sr isotopes. Reversing of post-entrapment crystallization allowed reconstructing the composition of the trapped komatiite melts.

For the first time we report results of the challenging task of obtaining Sr isotopes data from melt inclusions with low Sr concentrations around 35 ppm. Initial $^{87}Sr/^{86}Sr$ values range from very low 0.6998 ± 0.0003 to 0.7028 ± 0.0012 corrected for the emplacement age of 3.3 Ga. Thus compared to Bulk Silicate Earth (BSE) Pioneer melts have both significantly enriched and highly depleted components, and the last suggests the model age of separation from the BSE source $\geq$ 3.8 billion years. Studied melts also show a strong positive linear correlation between K and Cl contents and suggest contamination of the component enriched by K, Cl, Na, Rb, Sr and H_2O. We conclude that komatiite melts originated in the deep mantle source, which underwent first stage melting event at least 0.5 Ga before. Near surface these melts experienced a significant assimilation-fractional crystallization (AFC) process.